Directing migration of endothelial progenitor cells with applied DC electric fields.

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Public Summary:
The authors in this research use electric fields to guide and stimulate migration of endothelial progenitor cells to repair blood vessels. During repair of damaged tissues, endothelial progenitor cells are recruited to the damaged site to help repair the damaged. The damaged parts also generate small electric fields. The authors speculate that the electric fields may be used to stimulate migration of endothelial progenitor cells. They demonstrated that applied electric fields guided migration of the progenitor cells. This suggest the possibility of using electric fields to facilitate migration of endothelial progenitor cells to repair damaged to blood vessels, thus help regeneration.

Scientific Abstract:
Naturally-occurring, endogenous electric fields (EFs) have been detected at skin wounds, damaged tissue sites and vasculature. Applied EFs guide migration of many types of cells, including endothelial cells to migrate directionally. Homing of endothelial progenitor cells (EPCs) to an injury site is important for repair of vasculature and also for angiogenesis. However, it has not been reported whether EPCs respond to applied EFs. Aiming to explore the possibility to use electric stimulation to regulate the progenitor cells and angiogenesis, we tested the effects of direct-current (DC) EFs on EPCs. We first used immunofluorescence to confirm the expression of endothelial progenitor markers in three lines of EPCs. We then cultured the progenitor cells in EFs. Using time-lapse video microscopy, we demonstrated that an applied DC EF directs migration of the EPCs toward the cathode. The progenitor cells also align and elongate in an EF. Inhibition of vascular endothelial growth factor (VEGF) receptor signaling completely abolished the EF-induced directional migration of the progenitor cells. We conclude that EFs are an effective signal that guides EPC migration through VEGF receptor signaling in vitro. Applied EFs may be used to control behaviors of EPCs in tissue engineering, in homing of EPCs to wounds and to an injury site in the vasculature.